MISCELLANEA ZOOLOGICA HUNGARICA
Tomus 6. 1991. p. 5–12

Changes of the fish assemblages in the Kis-Balaton Reservoir between 1985 and 1989

by
B. CSÁNYI
(Received June 25, 1991)

Abstract: Faunistical survey and community structure (relative frequency) data collection were carried out to follow the structural composition of fish populations. Considerable change was revealed in the abundance pattern of the fish stock during the study due to the intensive fishing impact being continuous in the reservoir since 1988. The overall dominancy of non-indigenous species has been detected (*Carassius auratus gibelio*, *Pseudorasbora parva*, *Lepomis gibbosus*) together with the important decrease of the carp and the pike stock. The future fish stock management needs obviously regulations concerning selective fishing, replacement or other biomanipulatory techniques.
Key words: fish fauna, colonization, relative frequency, fish stock management

INTRODUCTION

The Kis-Balaton Reservoir (Fig. 1) connected directly to the River Zala has been established in 1985, having approximately 20 km^2 surface area and an average depth of 1.4 m. The river water enters the flooded area through the broken section of the former protecting embankment and leaves the reservoir through sluices that can be passed by fishes occasionally.

Functioning as a prereservoir, the establishment has an important role in the eutrophication control of the Lake Balaton. Large amount of the inorganic P- and N-compounds is taken up by the biota, starting with primary producers. A wide range of biological mass transport possibilities are realized in the reservoir, where the fish assemblage has a considerable importance.

Since the beginning of the operation the spatial heterogeneity of the reservoir was observed taking into consideration the routine physical and chemical analyses done by the District Water Authority (Keszthely) and the community structure of different biological compartments (plankton, benthon, nekton) described by the Research Centre for Water Resources (VITUKI, Budapest). Multivariate methods were applied (PODANI 1988) in order to reveal relationships between water quality and aquatic communities (CSÁNYI *et al.* 1989).

Three main objectives were formulated during the research program:

1. Description of the initial fish fauna after inundation;
2. Observation of the colonization and the important structural changes of fish communities in time;
3. Elaboration of a fish stock management strategy that is depending on the primary function of the reservoir concerning water quality management.

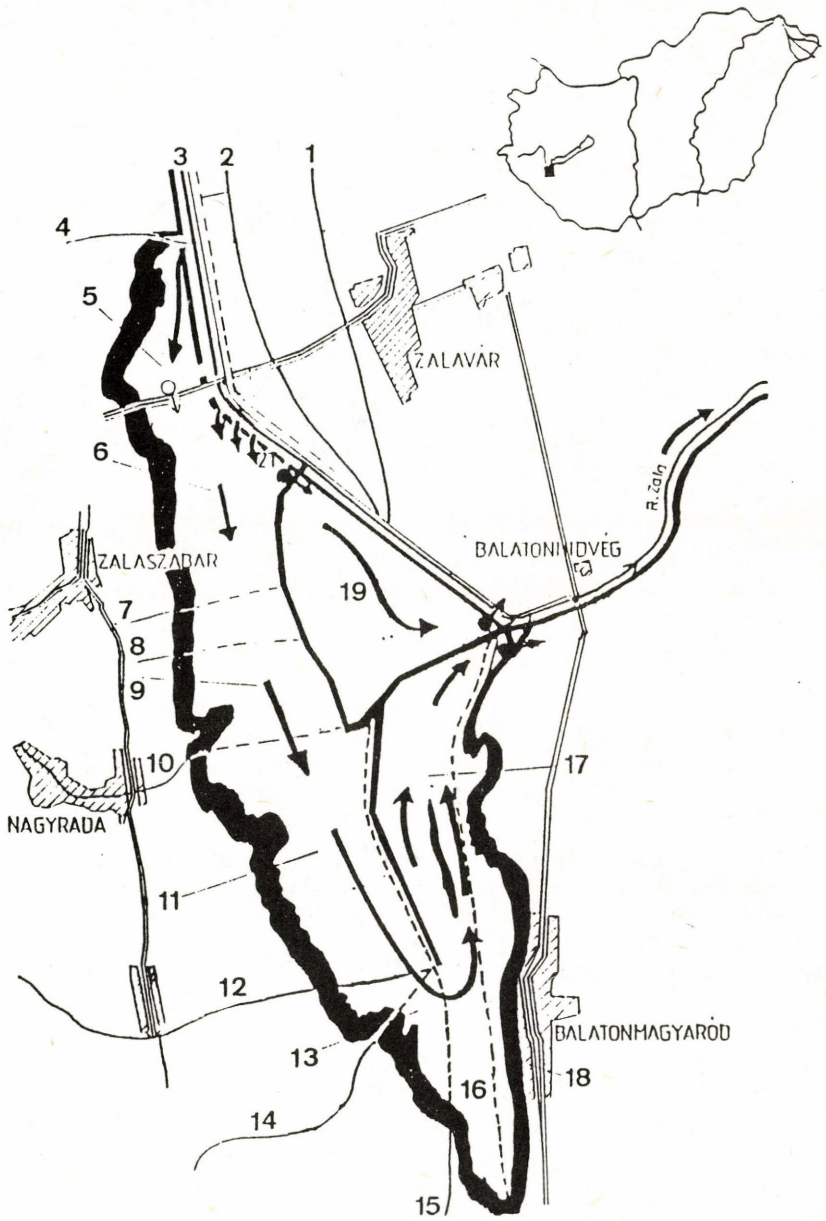

Fig. 1. Map of the Kis-Balaton Reservoir and the inflowing waters (arrows indicate flow direction). Numbers refer to the inflowing waters and parts of the reservoir: 1-2, Kis-Zala; 3, River Zala; 4, Bárándi creek; 5, Bárándi basin; 6, Szabari basin; 7, Szabari creek; 8, Pogányszigeti creek; 9, Pogányvári basin; 10, Radai creek; 11, Radai basin; 12, Garabonci border creek; 13, Garabonci basin; 14, Garabonci mill channel; 15, Kiskomáromi channel; 16, Sanyari mill creek; 17, Kányavári basin; 18, Magyaródi basin; 19, Casette

METHOD AND MATERIAL

Due to several theoretical and practical difficulties the quantitative estimation of the statistic variables of the fish populations was intentionally avoided. First, because the description of the spatial structures in a population requires a fractional and systematic sampling of the field area under study (CHESSEL 1978). On the other hand, regarding the aleatory character of the fish samples, effective sampling of an aggregate population, statistically speaking, is ensured only by the use of the smallest sample size possible (GÉRARD & BERTHET 1971). Both of these requirements (small sized samples, fractional sampling procedures) need huge amount of effort, time and cost.

Considering the reservoir as an open system for fishes, a sampling strategy suitable for the problem in question was chosen. A combination of different fishing methods was thought most feasible for attaining the research objectives within the constraints of the present research program. An electrofishing equipment, a 20 m long trawling net and a small lifting net (2 mm mesh size) with a long handle were used for sampling the juveniles and the small sized species. The adult stock was captured by trawling, trapping and gill nets with various length (10-50 m) and mesh size (30-55 mm). The electrofishing apparatus was also effective to catch the adult fish specimen.

The experimental fishing took place in the various basins of the reservoir. Both the open water areas and the littoral zones, having different aquatic plant communities, were investigated approximately with the same fishing effort: the fish sampling was repeated 7-11 times a year with the duration of 3-5 days at each case. Only the yearly average relative frequency changes were analysed.

RESULTS

The validity of population statistics in fish studies depends on sampling methods. Studies dealing with fish population dinamics usually elaborate methodology to estimate the size of age groups, particularly the juvenile cohorts (e.g.Point Abundance Sampling, NELVA *et al.* 1979, COPP 1990). Several effective capture technics were developed which can be simultaneously used (MANN & PENCZAK 1986) in fish surveys.

BERINKEY (1972) indicated the presence of 15 fish species in the surrounding catchment area of the River Zala. Faunistical research was carried out in the Kis-Balaton Reservoir and the catchment area of the Lake Balaton between 1986 and 1990 by BÍRÓ (1990) including the description of the allometric growth of different species. His results concerning the colonization are different from ours: two very common species (the bitterling and the *Pseudorasbora* sp.) was absent and very rare, respectively, during 1988. Another difference between his and our experiences is that we have never found *Leuciscus cephalus* in the reservoir area during the study period.

The results of our study led to the following conclusions: the drastic structural change of the community requires regulation both in fishing and species replacement. The yearly average relative frequency data and the abundance class values (established on logarithmic scale) can properly describe the characteristic changes in the fish stock due to different impacts (LEGENDRE & LEGENDRE 1983).

The number of taxa found in 1985 was 13 that has increased to 19 in the next

year. In 1989, 3 additional taxa were captured (Table 1): they were found in the Kiskomáromi-channel upstream to the reservoir in the summer of 1989. They are obviously not the members of the fish stock living in the eutrophic water body. Their presence close to the reservoir - especially the river goby (*Neogobius fluviatilis*) - has a faunistical importance.

The dominant species of the adult fish stock caught in 1985 were the crucian carp (*Carassius auratus gibelio*) and the carp (*Cyprinus carpio*) with 43.9 and 20.9 % relative frequencies, respectively. The amount of tench (*Tinca tinca*) was 8.6 %, the pike (*Esox lucius*) occurred in 4.5 %, and the other species were represented only occasionally. The specimens of the far-eastern *Pseudorasbora parva* were found already in the first year. The largest amount of juveniles came from the bleak population (*Alburnus alburnus*, 60 %), followed by the bream (*Abramis brama*) and the crucian carp (13.6 and 11.9 %, respectively).

Table 1. Values of abundance classes based on yearly average relative frequency data of fish taxa caught in the Kis-Balaton Reservoir. (Legend: 0 = absence; * = presence; other numbers = values for abundancy classes based on yearly averages of relative frequencies (RF): 1 if RF < 4 %; 2 if RF <8 %; 3 if RF <16 %; 4 if RF <32 %; 5 if RF <64 %).
NOTE: all of the data collected by different fishing methods are included!

SPECIES LIST	1985		1986		1989	
	Juv.	Ad.	Juv.	Ad.	Juv.	Ad.
Esox lucius	1	2	1	2	1	1
Cyprinus carpio	2	4	2	3	1	1
Abramis brama	3	1	2	1	*	1
Alburnus alburnus	5	1	4	3	1	0
Blicca bjoerkna	0	1	*	1	*	0
Aspius aspius	0	0	0	*	1	1
Carassius carassius	1	1	*	1	1	*
Carassius auratus gibelio	3	5	3	4	4	5
Rhodeus sericeus amarus	0	0	1	2	3	3
Rutilus rutilus	1	1	2	3	2	1
Scardinius erythrophthalmus	1	1	2	2	1	1
Tinca tinca	1	3	2	3	2	2
Misgurnus fossilis	0	0	0	*	0	0
Lepomis gibbosus	0	0	2	2	4	3
Perca fluviatilis	0	0	*	1	1	1
Gymnocephalus cernuus	0	0	0	0	0	1
Pseudorasbora parva	1	1	1	1	4	3
Silurus glanis	0	*	0	*	0	*
Anguilla anguilla	0	0	0	1	0	1
Hypophthalmichtys molitrix	0	1	0	*	0	*
Leuciscus cephalus	–	–	–	–	–	*
Cobitis taenia	–	–	–	–	–	*
Neogobius fluviatilis	–	–	–	–	–	*
Total number of individuals	546	244	768	422	675	1243
Total number of taxa		13		19		19

The basic dominancy conditions have changed in the second year because other cyprinids became common. The relative frequency of the crucian carp decreased to 23.9 %, and the roach (*Rutilus rutilus*), the rudd (*Scardinius erythroph-*

thalmus), the carp, the bleak and the pumpkinseed were the dominant species among the adults. The abundance class values of cyprinids among juveniles indicate the increment of the population size, too. The occurrence of the bitterling (*Rhodeus sericeus amarus*), the asp (*Aspius aspius*),the eel (*Anguilla anguilla*), the weatherfish (*Misgurnus fossilis*), the pumpkinseed (*Lepomis gibbosus*) and the perch (*Perca fluviatilis*) was registered for the first time in 1986.

Between 1986 and 1988 the contracts for fish studies were lacking and the next survey has been started only in 1989. In the mean time the Balaton Fishing Cooperative received the licence for fishing in the Kis-Balaton Reservoir in 1988 with certain restrictions of space, time and fish size. The detailed catch data of the Cooperative are not available this way the further evaluation of the fish stock development has to be based on our sampling data collected during 1989.

Three of the non-indigenous species became the most common: the crucian carp, the *Pseudorasbora parva* and the pumpkinseed. The relative frequency of the crucian carp exceeds 50 % of the total catch. The stock of the bitterling has increased also and the tench still has a considerable frequency. All of the other taxa have shown drastic decrease in their population size compared to the former values.

The lack of information on impacts of legal and illegal fishing activities taking place in the reservoir makes the complex evaluation difficult. On the other hand, the effect of selective fishing of the most valuable species (carp, pike) on the overall community structure was demonstrated by the recent changes of the abundance pattern experienced in the Kis-Balaton Reservoir. The relative frequencies of these most valuable species having the strongest fishing impact were very small in 1989. At the same time, the overall dominancy of the crucian carp became characteristic in all of the basins of the reservoir. This species, having advantages in its reproduction strategy, is not the target of the official fishing actually.

Table 2. shows the relative frequency data collected by trapping and gill nets illustrating the characteristic changes of the fish assemblages in the last five years.

Table 2. Relative frequency values (yearly averages) of fish species captured by trapping and gill nets in the Kis-Balaton Reservoir
NOTE: Data of small-sized species are not included.

TAXA	1985	1989
	(Relative Frequency, %)	
Esox lucius	4.5	1.5
Cyprinus carpio	20.9	0.8
Abramis brama	2.8	1.5
Aspius aspius	0	1.3
Carassius carassius	0.8	0.2
Carassius auratus gibelio	43.9	83.0
Rutilus rutilus	2.0	0.8
Scardinius erythrophthalmus	3.1	2.0
Tinca tinca	8.6	7.9
Perca fluviatilis	0.2	0.6
Silurus glanis	0	0.1
Total number of individuals	212	810

CONCLUSIONS

The basic purpose of the fish-faunistical research was to reveal the process of colonization. After two years of study our advise to reservoir management authorities was to let the stock reproduce itself and colonize new habitats without any control. The colonization and the diversification of the initial fish fauna was indicated in the second year already. This change was essential for the improvement of water quality and the nutrient uptake: the more diverse trophic network means the higher efficiency of nutrient removal.

However, the responsible authorities decided to give the fishing licence to the Balaton Fishing Cooperative and the local permission to anglers after three years in order to promote the multilateral utilization of the reservoir.

According to our opinion, this decision was made too early:

1. The stabilization of the fish fauna was not proved;
2. The detailed description of hydrobiological processes were not achieved.

The important changes of the community structure indicated in our study support the need of controlled interventions. A comprehensive fish management strategy can be proposed only in case of detailed knowledge about the mass and energy transport processes taking place in the reservoir, including all kinds of important compartments of the biota.

REFERENCES

BERINKEY, L. (1972): Magyarország és a szomszédos területek édesvizi halai a Természettudományi Múzeum gyűjteményében (Süsswasserfische von Ungarn und der angenzenden Gebiete in der Sammlung des Ungarischen Naturwissenschaftlichen Museums). - *Vertebr. Hung.*, **13**: 3-24.

BÍRÓ, P. (1990): Zárójelentés "A Kis-Balaton Védőrendszerben és a csatlakozó vízgyűjtő vizeiben a halállomány feltárása és a gazdasági hasznosítás lehetőségeinek megismerése" c., G-10 jelű OKKFT Program keretében végzett kutatásokról (1988-1990). Manuscript.

CHESSEL, E. D. (1978): Description non paramétrique de la dispersion spatiale des individues d une èspece. p. 45-135. - In: J. M. & R. TOMASSONE (eds): *Biométrie et ecologie*. Societé français de Biométrie.

COPP, G.H. (1990): Experimental design in fluvial ichthyology. - *Ann. Rep. F.B.A.*, **58**: 68-86.

CSÁNYI, B., P. GULYÁS & J. NÉMETH (1989): Hydrobiological survey of the Kis-Balaton Reservoir. - In: J. SALÁNKI & S. HERODEK (eds): *Conservation and Management of Lakes*, Symp. Biol. Hung., **38** : 517-527. Akadémiai Kiadó, Budapest.

GÉRARD, G. & P. BERTHET (1971): Sampling strategy in censusing patchy populations. p. 59-67. - In: G. P. PATIL, E. C. PILOU & W. E. WATERS (eds): *Statistical Ecology*. Penn. State Univ. Press, USA.

LEGENDRE, L. & P. LEGENDRE (1983): *Numerical Ecology*. - Elsevier Sci. Publ. Co., Amsterdam, Oxford, New York. p. 1-419.

MANN, R. H. K. & T. PENCZAK (1986): Fish production in rivers: A review. - *Pol. Arch. Hydrobiol.*, **33**: 233-247.

NELVA, A., H. PERSAT & D. CHESSEL (1979): Une nouvelle méthode d'étude

des peuplements ichtyologiques dans les grands cours d'eau par échantillonage ponctuel d'abondance. - *C. R. Acad. Sci. Paris*, **289** (D): 1295-1298.
PODANI, J. (1988): SYN-TAX III. User's Manual. - *Abstracta Botanica*, **12** (Suppl. 1.): 1-183.

Author's address: Béla CSÁNYI
Research Centre for Water Resources Development
(VITUKI),
H-1095 Budapest
Kvassay út 1.,
Hungary